Adhesion, lubrication and wear of aluminum

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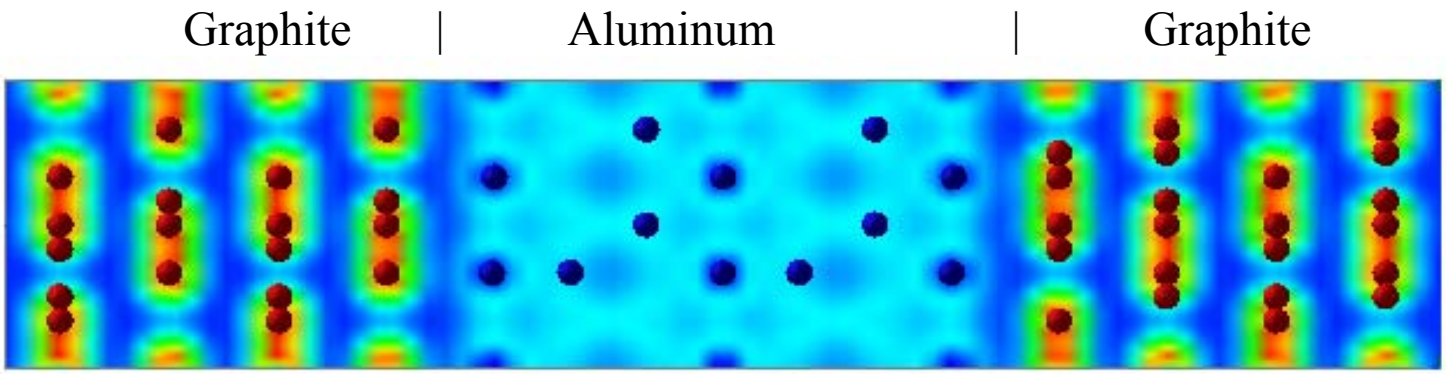
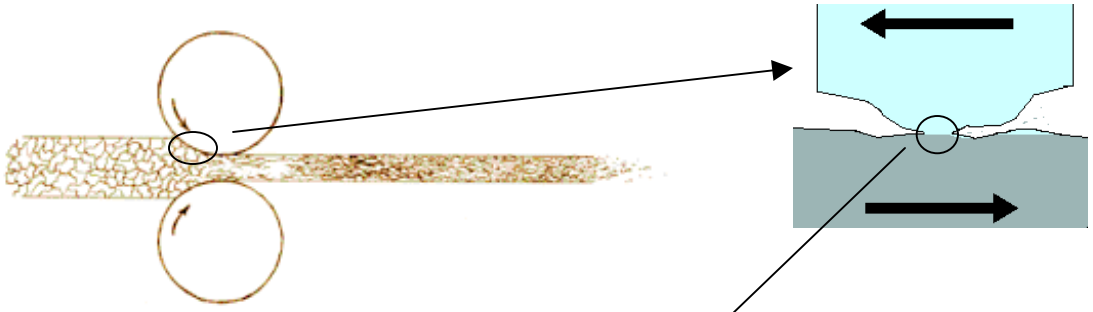
Our group has investigated the adhesion between aluminum and a wide variety of carbide, nitride, and oxide ceramics.

Below is an example of our study of the interaction between aluminum and graphite. Unlike other ceramics, graphite exhibits almost no bonding with aluminum, which explains why it is an excellent solid lubricant.



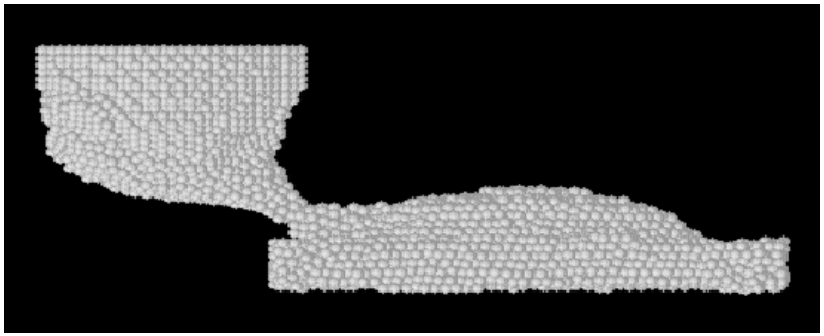
Charge density plot of Al – graphite interface shows almost no bonding across the interface → graphite is great lubricant for Al machining

When aluminum is forced into contact with a typical tool steel, there is a major exothermic reaction to form Al2O3.
We have recently simulated interactions between asperities of Aluminum and a hard "Lennard-Jones" material, for the special case of a high reaction enthalpy.



Hot/cold rolling of aluminum causes roll pickup

Surfaces are not smooth on microscopic level



Shearing of asperities

→ strong chemical bonding

→ friction welding

→ more wear of Al surface

Educational Impact

Education:
Two graduate students in Materials Science and Engineering, Robab Shakiba and Newton Ooi, contributed to this work.

Based on their research, we created 5 computer lab activities for a graduate course in **Multi-Scale Modelling of Materials** taught by Prof. Adams.

Also, Drs. Louis Hector and Y.T. Cheng of General Motors have been actively involved in advising the graduate students, co-authoring papers, and hosting the students for visits at GM.